

MANUAL

User Manual for
Sunways Solar Inverter NT 10000

SOLAR INVERTERS

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Sunways Solar Inverter NT 10000

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1.1 Safety Instructions

The user manual contains safety instructions. They are marked by a triangle with an exclamation mark.



General Safety Instructions

All safety instructions contained in this section as well as in the entire user manual must be observed to ensure the safety of the user. The described product may not be operated if any mechanical or electrical component is defect.

Prior to commissioning the PV system, we strongly recommend reading and observing the manual and the instructions carefully! Non-compliance may lead to serious consequences such as damage to the device, damage to other assets, personal injury, or fatal accidents.

The Solar Inverter may only be installed by a trained and qualified electrician. It must be approved by the power supply company in charge. In the chapter headings, the due steps are additionally marked by the adjacent symbol.



Opening the Device

Prior to opening the housing, always disconnect the device from the grid and the PV generator.

After having been disconnected from the PV generator, there is still lethal voltage inside the device and at the PV generator hubs for approximately five minutes. It takes that long for the energy-storing capacitors to fully discharge.

After having disconnected the device from the grid and the PV generator, wait at least five minutes before opening the device.

1.2 Sunways Solar Inverter NT 10000

Scope of Delivery

- Sunways Solar Inverter NT 10000
- assembly frame
- user manual, setup, guarantee card, CD ROM with software
- 3 pairs of Tyco Solarlok connectors

Checking the Consignment

Prior to shipment, our products are checked to make sure they are in a perfect condition. They are carefully packaged in recyclable materials. Nevertheless, damage may occur during transportation which is normally the fault of the forwarding company.

Please check the delivered Solar Inverter carefully!

Should you notice any damage to the packaging or to the Solar Inverter, please notify the forwarding company immediately. If required, your specialist dealer will be glad to support you. If a damage report is needed, it must be filed with the forwarding company no later than seven days after receipt of the consignment.

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Integrating the Solar Inverter in the PV System

Rating of the PV Generator

The technical data of the selected PV generator must be compatible with the specification of the Solar Inverter (see Technical Data). An incompatible rating may reduce the yield or destroy the device. The rating program Sunways NT Sundim can help you select the correct PV generator rating. You will find Sunways NT Sundim on the enclosed CD ROM or on our homepage www.sunways.de.

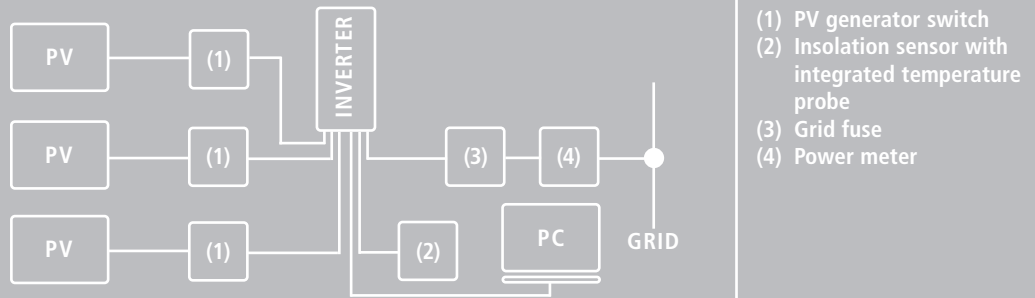
Prior to planning your system, please take the following considerations into account:

- Mind the orientation of the modules.
In Central Europe, you will gain a maximum yield if the module has a horizontal angle of 30° and the PV generator field points directly towards the south.
- The warmer the module gets, the smaller the output of the cells will be. Therefore, make sure your PV generator has sufficient back ventilation when you install it.
- Check your PV generator for contamination approximately every three years. Contamination mostly occurs on the lower edge of the module; it forms a veil that is not even washed off by heavy rain. A loss of yield can be prevented by cleaning the modules with a wet cloth or a brush.
- Make sure none of the modules or solar cells of your system are in the shade. That may lead to a significant loss of yield.
- The NT 10000 has three internal energy units that are supplied by three independent PV generators. The NT 10000 is based on the «MPP multitracking» principle; i. e. each inlet has its own MPP controller.

Standard Components of a PV System

Depending on the recommendations of your PV planner, your PV system is made up of the following components:

Standard components of the PV system



The PV generator switch is designed as a DC switch-disconnector and is made for disconnecting the PV generator from the Solar Inverter.

Rating: at least 900 V, ≥ 16 A

Since the NT 10000 is supplied by three independent PV generators, the DC main switches must also be independently of each other. It can be designed as a packet-type switch, for example.

Grid connection:

The NT 10000 is connected to the grid in three phases. Each phase is internally controlled and monitored independently of the others.

Structure of NT 10000

The Solar Inverter NT 10000 is made up of three energy units that are controlled independently of each other. Each energy unit has its own DC inlet.

Energy Unit	DC Inlet	Control Circuit Board	AC Grid Connection
Energy unit 1	DC inlet 1	Control circuit board 1	Phase L1
Energy unit 2	DC inlet 2	Control circuit board 2	Phase L2
Energy unit 3	DC inlet 3	Control circuit board 3	Phase L3

The following illustration shows the connection of the DC inlet and the layout of the energy unit:

Protection Concept

The micro controller continuously and simultaneously monitors and displays the following parameters. Numbers 1 to 3 refer to the energy units 1 to 3:

The numbering 1 to 3 refers respectively to the performance unit 1 to 3:

Error No.	Description	Error	Description
001	DC overvoltage 1	No.021	Insulation fault 2
002	DC overvoltage 2	022	Insulation fault 3
003	DC overvoltage 3	023	DC injection 1
004	Frequency fault 1	024	DC injection 2
005	Frequency fault 2	025	DC injection 3
006	Frequency fault 3	026	Isolated operation
007	Overheating of heat sink 1	027	Grid overvoltage 3-phase
008	Overheating of heat sink 2	028	Surge fault 1
009	Overheating of heat sink 3	029	Surge fault 2
010	Grid undervoltage 1-phase 1	030	Surge fault 3
011	Grid undervoltage 1-phase 2	031	Grid voltage 10 minutes mean value > 10 percent U_{nominal} 1
012	Grid undervoltage 1-phase 3		
013	Grid overvoltage 1-phase 1	032	Grid voltage 10 minutes mean value > 10 percent U_{nominal} 2
014	Grid overvoltage 1-phase 2		
015	Grid overvoltage 1-phase 3	033	Grid voltage 10 minutes mean value > 10 percent U_{nominal} 3
016	Grid undervoltage 3-phase		
017	AFI fault 1	034	Control circuit board 1 fault
018	AFI fault 2	035	Control circuit board 2 fault
019	AFI fault 3	036	Control circuit board 3 fault
020	Insulation fault 1	038	Back-up battery empty

In case of an error, the current injection is immediately stopped, and the grid relay is triggered which disconnects the Solar Inverter from the grid.

In addition, there are the following protection devices on the grid side and on the PV generator side:

- Varistors on the grid side
They protect the power semiconductors in case of high-power, temporary voltage peaks in the grid, and they discharge the throttle in case of disconnection from the grid.
- Varistors on the PV generator side
Varistors offer protection from atmospheric overvoltage (e. g. caused by remote lightning strikes).

2.1 Safety Instructions



Electrical Safety

Prior to opening the housing, disconnect the Solar Inverter from the electricity of the grid and the PV generator.

After disconnection from the PV generator and the grid, there is still lethal voltage inside the Solar Inverter and at the PV generator hubs for approximately five minutes. It takes that long for the energy-storing capacitors to fully discharge.

After having disconnected the Solar Inverter from the grid and the PV generator, wait at least five minutes before opening the Solar Inverter.

Mechanical Safety

During assembly, make sure the cables or connecting lines attached to the Solar Inverter are installed safely and suitable mechanical cable retaining devices (e. g. cable channels) are used.



Cleaning Instructions

Prior to cleaning your PV modules, always disconnect the PV system from the power grid by opening the grid disconnecting device (main fuse), and open the DC circuit breaker on the PV generator to prevent the risk of an electric shock.

Use a dry, soft cloth to clean your PV modules. Never use caustic, solvent-based, or scouring cleaning agents or polish.

Please observe the instructions of the PV module manufacturer.

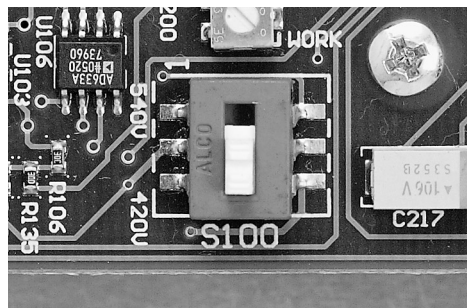
2.2 Basic Settings

Setting the Fixed Voltage Level

Your Sunways Solar Inverter is equipped with a precise MPP control. If less than 200 watt are injected, the control of the energy unit concerned operates at a fixed voltage level. That prevents unnecessary MPP searching. To minimise adjustment losses during fixed voltage operation, the fixed voltage level of each energy unit of the Solar Inverter can be set separately. The optimum fixed voltage level depends on your PV generator model.

Fixed voltage level	No-load voltage PV generator at 25 °C
420 V	≤ 630 V
540 V	> 630 V

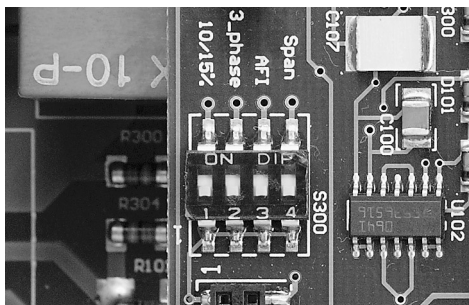
The fixed voltage can be set with the slide switch «S100» on the control circuit board. Ex works, the switch is set to «420V». To set a fixed voltage of 540 V, slide the switch to the «540V» position.





Illustr.: Slide switch «S100» for setting the fixed voltage level

Country Settings

Please note that it takes different configurations to operate Sunways Solar Inverters in different countries. The setting can be adjusted accordingly with the DIP switch «S300» below the display circuit board.



Illustr.: DIP switch «S300» for changing the country setting

Country	Switch position	Change
Germany	<p>Voltage AFI 3-phase 10/15%</p> 	
Spain	<p>Voltage AFI 3 phased 10/15%</p> 	<ul style="list-style-type: none"> · Opening time after power failure: 3 · Grid monitoring 1-phase

To change the country setting, the housing cover must be removed. The DIP switch must be re-positioned to the respective country setting on all three control circuit boards.

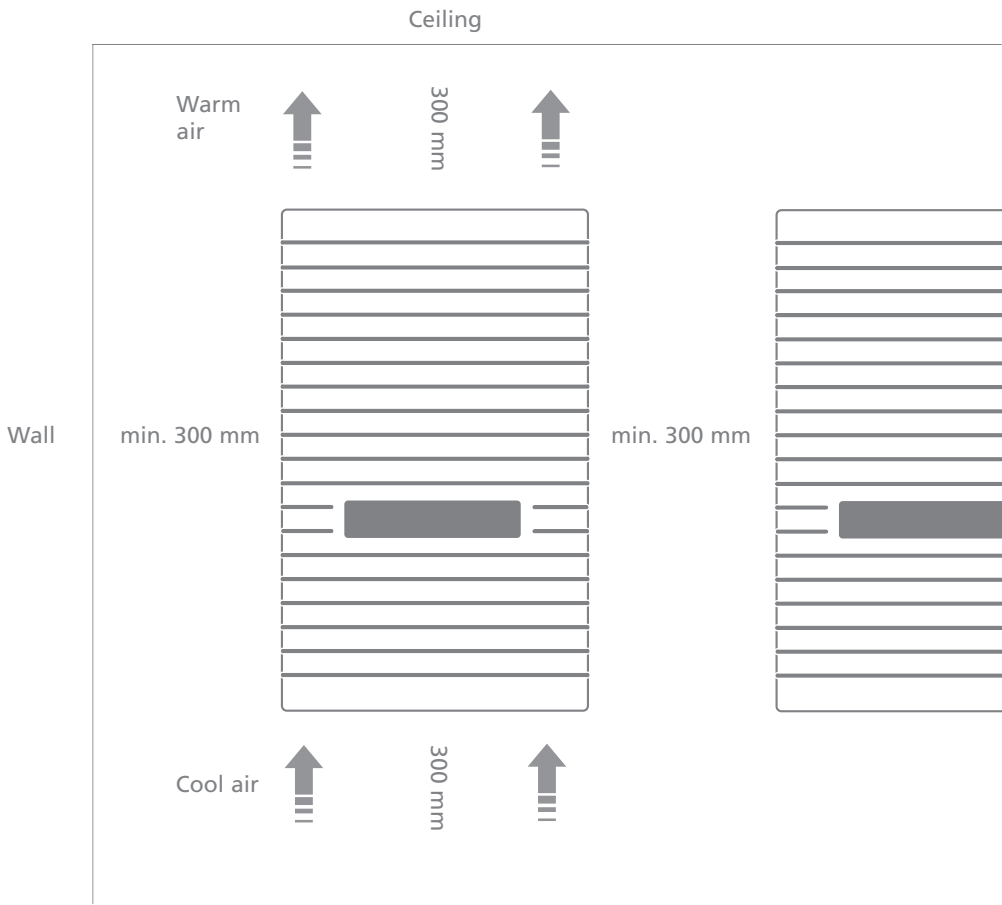
When delivered, the Solar Inverters are pre-set to the intended destination country. The pre-set country is indicated by the first two digits of the serial number:

Germany	00.....
Spain	02.....

2.3 Installation



The Solar Inverter may only be installed by a trained and qualified electrician. Special tools are needed for installation. Please read this chapter very carefully.



Installation Site Requirements

· Mechanical Load-Bearing Capacity

During assembly, please keep in mind that the Solar Inverter weighs 30 kg. The assembly foundation must be solid and capable of bearing the weight in the long run.

· Thermal Interaction

The assembly foundation must be made of flame-retardant material (unsuitable: wooden or plastic foundation; suitable: concrete and masonry), because the frame of the Solar Inverter can reach up to 70° C.

Maintain a minimum distance of 300 mm to other devices, cabinets, ceilings, cable channels, etc. above, below, and next to the housing.

The Solar Inverter must be installed in an upright position to ensure unobstructed convection.

Do not install several Solar Inverters on top of each other, as they might heat each other up.

If the Solar Inverter is installed in a switch cabinet, make sure the heat is removed to a sufficient degree.

The ambient temperature may not drop below -25° C or rise above +40° C.

To protect the Solar Inverter from unnecessary external heat sources, do not expose the Solar Inverter to direct sunlight.

· Protection from Moisture and Foreign Objects

Thanks to the high protection level IP 54, the Solar Inverter can be installed indoors as well as in a sheltered outdoor area, but it may not be directly exposed to rain.

Make sure the dust filter on the lower left side is not clogged by contamination. That would impair the intake of cooling air. Depending on the surroundings, the filter should be cleaned at regular intervals.

Mechanical Installation



For assembly, please observe the instructions in the «Setup» leaflet!

Electrical Connection and Cable Entry



As soon as the Solar Inverter is fixed to the assembly frame, it can be electrically connected. The device may only be opened by a qualified electrician. For this purpose, loosen the four lateral hexagon socket screws by one rotation. The cover can now be moved up to the upper rabbet. Fix the cover in position by simply inserting the hexagon key on the lower right side. The wiring space is now accessible.



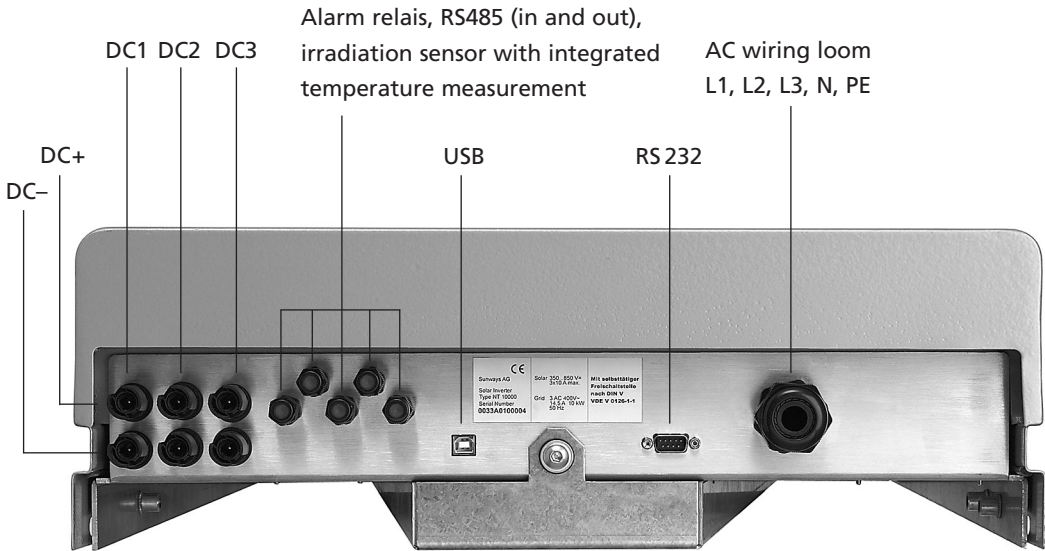
Grid Connection

The Solar Inverter must be connected to the grid with five-cores (L1, L2, L3, N, PE). We recommend a cable cross-section of $5 \times 4 \text{ mm}^2$.

The Solar Inverter is connected to the supply grid via its internal printed-circuit board terminals.

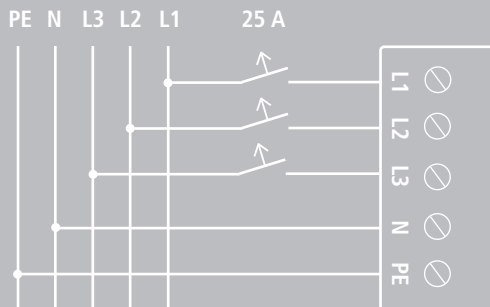
As an input-to-grid line protection element, we recommend using a $3 \times 25 \text{ A}$ automatic circuit breaker for the NT 10000. No consumers may be connected to the supply line from the Solar Inverter to the automatic circuit breaker. The Solar Inverter injects in three phases via terminals L1, L2, and L3. Please mind the pin assignment. A wrong assignment may destroy the device.

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Illustr.: Entry openings on the underside of the device

Three-phase grid connection



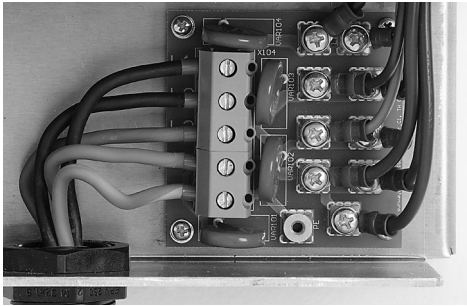
Always use sufficiently dimensioned cable cross-sections to prevent a significant increase of the grid impedance between the service distribution system and the Solar Inverter. The capacity of the AC terminals is 0.5 mm^2 to 6 mm^2 for rigid cables, and 0.5 mm^2 to 10 mm^2 for flexible cables. If the grid impedance is high, i. e. due to relatively long or thin cables, the voltage at the grid terminal is increased during injection. If the terminal voltage exceeds the admissible value, the Solar Inverter is disconnected from the grid. If the power grid is weak and the PV output is high, individual Solar

Inverters may repeatedly switch on and off.

Carry out the following steps carefully:

- Prior to inserting the power cable into the device, make sure it is de-energised.

- Insert the five-core AC cable (outer diameter 9–17 mm) into the M32 cable gland.
- Connect lines L1, L2, L3, N, and PE to the slotted printed circuit board terminal with a slotted screwdriver.



- Pull the M32 cable gland tight, so the cable cannot exert mechanical force on the printed circuit board terminal.

Connecting the PV Generator



· Preparation

Please note that the NT 10000 has three independent DC inlets. The PV generators may have different ratings, but they must be compatible with the specifications of the Solar Inverter.

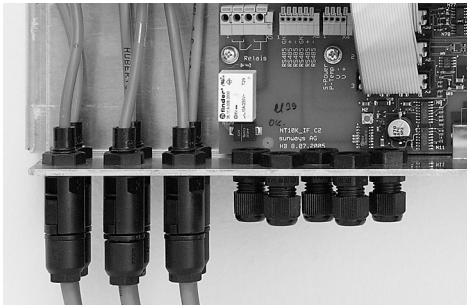
1. Install the DC cables in accordance with the system ratings prescribed by your PV planner. Measure the no-load voltage and the short-circuit current of each PV phase to make sure they work perfectly.
2. Read the type plate of the Solar Inverter to make sure it is licensed for the maximum PV generator voltage.
3. To avoid dangerous touch voltage during the assembly of PV systems, the positive and negative conductors must be kept away from the earth potential (PE) electrically.
4. Accessible and conductive parts of the PV generator (e. g. metal frame, support structure, etc.) must be earthed (connection to PE).
5. Make sure the PV generator is earth-fault free.
6. Connect the Solar Inverter to the power line.

· Connection

The PV generator is connected by means of the externally accessible, touch-safe Tyco Solarlok connectors included in the consignment. The Tyco Solarlok connectors are designed for a cable cross-section of 4 mm² and have to be crimped. For further information, please read chapter 4.2 «Tyco Solarlok Connectors».

Please note:

All PV generator inlets are positioned in pairs. Inlet 1 is left, inlet 2 is in the middle, and inlet 3 is right. The upper connections are «POSITIVE», and the lower ones are «NEGATIVE».



Illustr.: PV generator connection via Tyco Solarlok connectors

Important Information



- The DC voltage can reach up to 850 V. The device may only be opened by a qualified electrician!
- As soon as the PV generator has been connected to the Solar Inverter by means of the DC connectors and the PV generator has been switched on, the PV generator voltage is applied internally!
- Please note that the inlet capacitors are still live, even after the PV generator has been switched off or the PV generator connector has been pulled out!
- After the AC and DC sides have been isolated, the Solar Inverter remains live for up to approximately five minutes!
- Therefore, wait at least five minutes for the internal voltage to discharge. Prior to working on the Solar Inverter, always

check the residual DC voltage with a voltmeter. Then you may work on the terminals. See chapter 2.1.

- Always disconnect the PV generator side first by opening the PV generator switch; then interrupt the grid connection by isolating (switching off) the corresponding grid fuse!
- Never disconnect the PV generator by pulling out the Tyco Solarlok connectors under load. Otherwise a powerful electric arc might damage the connectors. The damaged connectors then have to be replaced!
- If your PV system does not have a PV generator switch, interrupt the grid connection by isolating (switching off) the corresponding grid fuse first. A fault will then be recorded in the fault memory of the Solar Inverter, however.

Communication Interfaces



The communication interfaces enable you to retrieve operating data from the data memory with an external computer and to change certain settings. There are several communication interfaces: USB, RS232, and RS485.

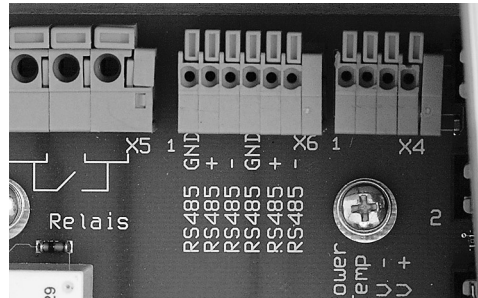
The standard communication interface is the USB interface which is installed in every common PC or Notebook. This interface will let you communicate with your Solar Inverter via an interconnecting USB cable. As an alternative, you can also use the RS232 interface. The RS485 interface is for cross-linking several Solar Inverters.

The USB and RS232 interfaces are connected on the outside of the housing with a standard USB connector or a SUB-D9 connector.



Illustr.: USB connector (left) and SUB-D9 connector (right) for the RS232 connection on the underside of the device.

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Illustr.: Terminal block for the RS485 connection

· **RS485 Wiring**

Solar Inverters NT 10000 can be cross-linked via RS485. When doing so, please keep in mind that the Solar Inverters must be connected in series. Cross-linking them point-to-point is not admissible. Interface RS485 is connected via the printed circuit board terminals and the corresponding M12 cable glands inside the housing. Prior to wiring the RS485, move the cover of the Solar Inverter up, and fix it in position by tightening a lateral screw. See chapter 2.1 «Safety Instructions».

The required cable terminal block («X6») with the connections «RS485 +», «RS485 -», and «RS485 GND» is in the lower section of the circuit board (see illustr. page 115).
Caution: There are two each of all terminals, so the ingoing and outgoing lines can be connected separately.

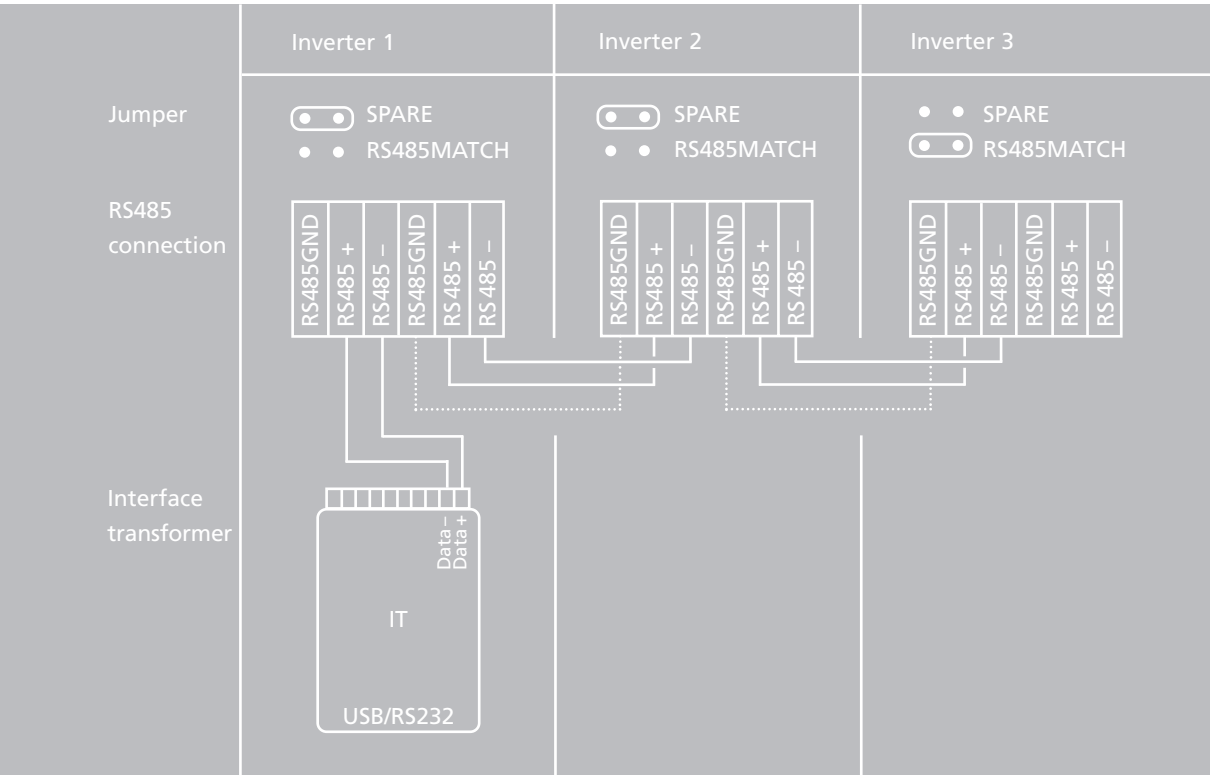
Use a twisted two-wire cable for the RS485 wiring of the Solar Inverter. Connect the terminals «RS485 +» between the Solar Inverters with one core and the terminals «RS485 -» with the other.

If you use a shielded twisted two-wire cable, you can earth the shield. That will improve the communication reliability.

With the last Solar Inverter, the jumper «RS485 MATCH» must be closed. With all other Solar Inverters, it has to be in the open position (see chapter 3.6 «Communication Link»).

· **Connecting a cable to the spring-loaded terminal**

- Use a small screwdriver. Press the orange terminal. The terminal will open.
- Insert the (at least 11 mm bare) cable into the respective terminal hole.
- Release the pressure from the screwdriver. The cable is now attached to the connection.
- Make sure the cable is connected tightly.



- Release the pressure from the screw-driver. The cable is now attached to the connection.
- Make sure the cable is connected tightly.

Connecting the Alarm Relay

All Sunways Solar Inverters are equipped with a potential-free alarm relay. The relay is designed as a make-contact element and is always triggered when the device reports an error. That ensures that any faults in the PV system are reported quickly and reliably on site. With PV systems with several Solar Inverters, the individual relays can be paralleled and connected via a joint indicator light.

The alarm relay cannot be triggered if there is a power failure on L1, because that is the supply phase for the Solar Inverter.

The alarm relay cannot be triggered if there is a grid failure on L1 since this is the supply phase for the solar inverter.

· Connection

Move the cover of the Solar Inverter up, and fix it in position by tightening a lateral screw. See chapter 2.1 «Safety Instructions».

The required terminal block with the connections «S-» and «S+» is on the lower right side of the circuit board («X5»). Allocate the terminals as shown:

· Important Information:

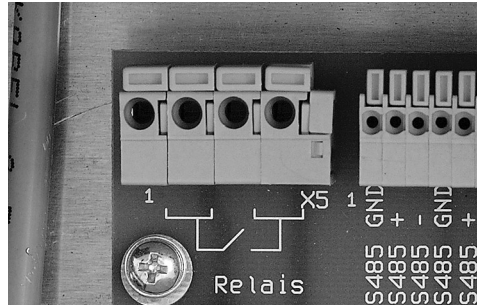


The alarm relay is rated for 230 V / 2 A. Any higher power/voltage may destroy the relay. The connected indicator module must be fused separately!

· Connecting a cable to the spring-loaded terminal

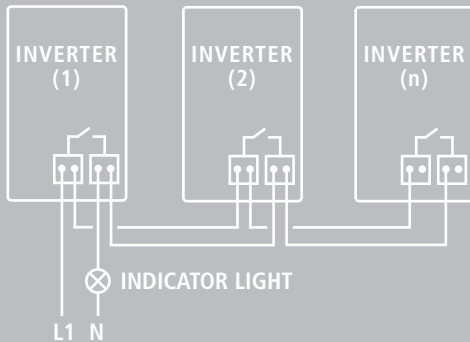
- Use a small screwdriver. Press the orange terminal. The terminal will open.
- Insert the (at least 11 mm bare) cable into the respective terminal hole.
- Release the pressure from the screwdriver. The cable is now attached to the connection.
- Make sure the cable is connected tightly.

The terminals are designed for a cable cross-section of 0.2 mm² to 1.5 m².
 When selecting the dimensions of the cross-section, please keep the power consumption of the connected indicator module in mind!

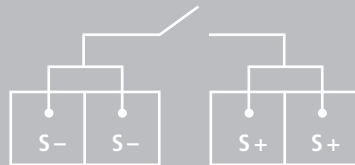


Illustr.: Alarm relay connection

Paralleled alarm relays of several Solar Inverters



Alarm relay terminal allocation

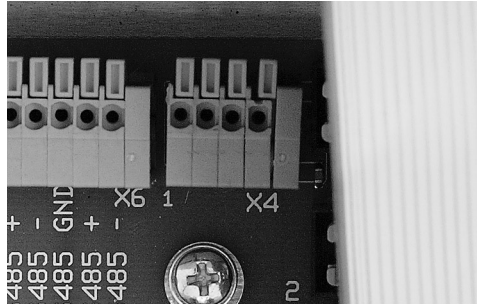


Connecting the Insolation and Temperature Sensor

The optional insolation sensor (type Si-01TC-T by Ing.-Büro Mencke & Tegtmeyer) with its integrated PT-100 temperature probe for measuring the temperature lets you record the insolation data and the corresponding module temperature and store them in the internal data memory as a 15-minute average value. This additional measuring unit helps you analyse the performance of the system. Based on the values, any faults in the PV generator, e. g. shaded or defect solar cells, can be detected.

Prior to connecting an insolation sensor, move the cover of the Solar Inverter up, and fix it in position by tightening a lateral screw. Please note that the inlets and outlets are not short-circuit-proof. Please observe chapter 2.1 «Safety Instructions».

The optional insolation sensor with the temperature probe is connected to the cable terminal block «X4» in the lower section of the circuit board.



Illustr.: Connection insolation sensor

· **Allocation of the cable terminal block:**

Pin allocation sensor connector	Sensor pin name	Solar inverter pin name
Pin 1	Plus signal temperature	S-Temp
Pin 2	Plus signal insolation intensity	P-Solar
Pin 3	Plus connection supply +5 V	V+
Pin 4	Earth reference	V-

- Use a small screwdriver. Press the orange terminal. The terminal will open.
- Insert the (at least 11 mm bare) cable into the respective terminal hole.
- Release the pressure from the screwdriver. The cable is now attached to the connection.
- Make sure the cable is connected tightly.

2.4 Commissioning the Solar Inverter

Prior to starting up the Solar Inverter, move the housing cover downwards by releasing the lateral fixation on the right lower side of the housing and pulling the four lateral hexagon socket screws tight.

Do not deposit any objects (e. g. this manual) on the housing of the Solar Inverter. The ventilation behind the Solar Inverter must not be obstructed.

If the device is installed outdoors, please double-check that the cable glands, the housing cover, and the protection cap of the SUB-D9 connector (provided this terminal is not allocated) are tight.

Starting-Up and Shutting-Down the Solar Inverter

As soon as the Solar Inverter has been mechanically installed and connected to the power lines, it can be commissioned as follows. Depending on whether or not you are using DC main switches, the start-up and shut-down sequence for the DC and AC side differs.

Note: The Solar Inverter is supplied from the grid. If the PV output is high enough, the Solar Inverter will switch on automatically. For that purpose, on and off threshold values have been determined.

Start-up (with DC main switch)

1. Switch the grid connection on with the external automatic circuit breaker.
2. Switch the PV generator voltage on by closing the DC main switch. If the PV input voltage is sufficient, the Solar Inverter will start and inject solar energy into the electrical grid. The injection is indicated by the power pointer on the display.

Start-up (without DC main switch)

1. Connect the Tyco Solarlok connectors to your Solar Inverter.
2. Start-up the AC side.

Shut-down (with DC main switch)

1. Disconnect the PV generator side by opening the DC main switch.
2. Open the grid connection by isolating (switching off) the corresponding grid fuse.
3. After a waiting time of at least five minutes, the Solar Inverter is deenergised.

Shut-down (without DC main switch)

1. Interrupt the grid connection by isolating (switching off) the corresponding grid fuse. A fault will then be recorded in the fault memory of the Solar Inverter.
2. Pull the Tyco Solarlok connector out of your Solar Inverter.



Never disconnect the PV generator by pulling out the Tyco Solarlok connectors under load! Otherwise a powerful electric arc might damage the connectors. The damaged connectors then have to be replaced!

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2.5 Dismantling the Solar Inverter

To dismantle the Solar Inverter, loosen the hexagon socket screws, and move the cover up. Make sure the Solar Inverter is de-energised; then remove the supply lines. The Solar Inverter may then be lifted out of the assembly frame.

3.1 Operating the Display

A dot matrix LCD display with 2 x 16 characters is integrated in the housing of the Solar Inverter. The language of the displayed messages can be selected (German, English, Spanish, Italian, or French). The four arrow keys to the right of the display are for navigating the menu structure. The background lighting of the display is activated by pressing any random key. It automatically switches off if no input is made for more than one minute.





As a standard, line one of the display shows the current total output of the Solar Inverter, and line two shows the partial output of the three energy units 1 to 3. This information is always displayed if no key is pressed for one minute.

· Menu Guide

Activate the main menu by pressing any random key. In the top menu level, there are four items to choose from:

- display current values
- display energy yield
- change settings
- display Solar Inverter specifications

· Navigating with the Arrow Keys

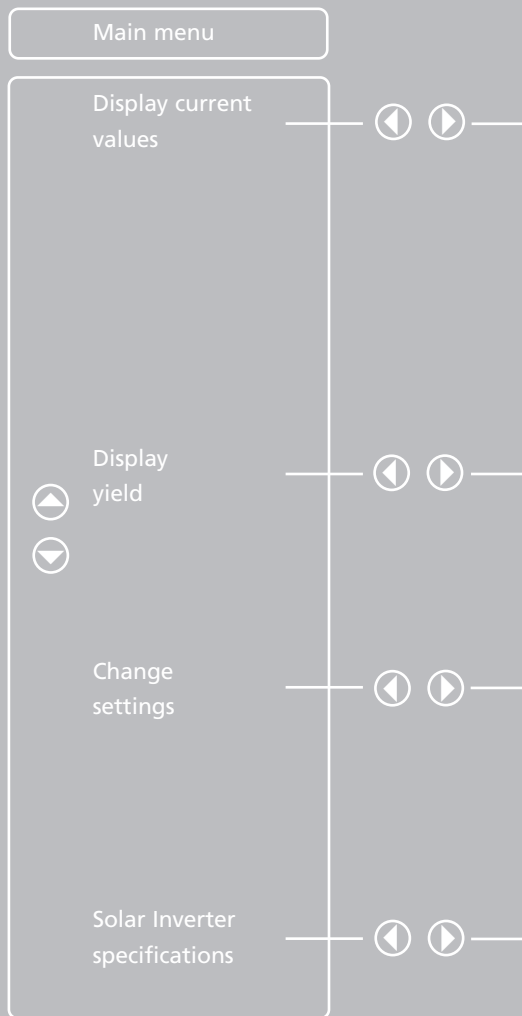
You can use the UP arrow  and DOWN arrow  keys to scroll within a menu level. To select a menu item, press the RIGHT arrow key . To return to a higher menu level, press the LEFT arrow key .

· Setting Values

To set values, move to the next figure by pressing the RIGHT arrow key. To change the current figure, press the UP/DOWN arrow key. If the cursor is on the last figure, you can confirm the input by pressing the RIGHT arrow key. To abort the changes during entry, press the LEFT arrow key.

If a displayed value can be changed, an arrow is shown behind it. In this case, press the RIGHT arrow key to reach the «edit» mode.

The current power and voltage values are displayed separately for each of the three energy units.



3.2 Configuring the Solar Inverter

You can enter the following settings in your Solar Inverter:

- set RS485 address
- set date / time
- set display language
- set LCD contrast
- set total yield

Please note that the configuration can only be changed when the Solar Inverter is operating. Alternatively, you can change these settings by using the enclosed software Sunways Monitor.

Setting the RS485 Address

To use the communication via the RS485 bus, the Solar Inverters must have consecutive RS485 addresses. That means, if you link three Solar Inverters together, their addresses must be 1, 2, 3. When delivered, address 1 is preset. To change the address, select the menu item «settings» / «RS485 address», and press the RIGHT arrow key to call up the «edit» mode. There, you can enter an address from 1 to 99.

Setting the Date / Time

To set the time or date, select the menu item «change settings» / «date/time», and move to the «edit» mode by pressing the RIGHT arrow key.

Setting the Display Language

To set the display language, select the menu item «change settings» / «language». Here, you can choose from the languages German, English, Spanish, French, and Italian by pressing the UP/DOWN arrow key. Confirm your input by pressing the RIGHT arrow key.

Setting the LCD Contrast

If you wish to change the LCD contrast to improve the clarity of the display, select the menu item «change settings» / «LCD contrast». Press the RIGHT arrow key to activate the «edit» mode; then select the desired contrast by pressing the UP/DOWN arrow key. To confirm your input, press the RIGHT arrow key.

Setting the Total Yield

If your Solar Inverter needs to be replaced, you can take over the total yield from the

former Solar Inverter to your new one. You can either take over the total yield of the device, or the individual yield of each energy unit. If you set the total yield of the device, it will automatically be split among the energy units 1 to 3 in equal shares. If you change the yield of the individual energy units separately, they will be added up to the total yield.

To do so, select the menu item «change settings» / «total yield». Here, you can select the total yield, energy unit 1, energy unit 2, or energy unit 3. To start changing the displayed value, press the RIGHT arrow key.

3.3 Internal Data Memory

Your Solar Inverter is equipped with an internal data memory as a standard feature. With the enclosed software Sunways Monitor, you can access these data. These Solar Inverter data will give you detailed information on the functioning method and relevant values of your solar energy supply at any time. The measured values are stored in a ring buffer that automatically overwrites the earliest values with the latest ones. The following measured values are stored in your Solar Inverter NT 10000:

15 minutes average values (500 data records, each with date/time):

- DC current
- DC voltage
- AC current
- AC voltage
- injected power
- insolation (optional)
- module temperature (optional)

In addition, the following total injected energy values (electrical output) are stored:

- daily yield (40 days)
- monthly yield (13 months)
- total yield (since commissioning)

The last 100 errors of the Solar Inverter are stored with their date, time, and error number.

Please note that, in the nominal case, all displayed values have a maximum measuring accuracy of 5 percent. The power meter of your power supply company is an absolute reference for the injected energy.

3.4 Sunways Monitor 2.0 Software

General Information

The visualisation software Sunways Monitor 2.0 is for monitoring the PV system and configuring the Sunways Solar Inverter with a PC. You can install it on your PC from the enclosed CD ROM.

To download the latest software version free of charge, please visit www.sunways.de on the Internet. Our system recommendation is:

- Intel Pentium with at least 500 MHz
- Microsoft Windows 98 Second Edition, Windows 2000, Windows XP
- Microsoft .NET-Framework 1.1
- 200 MB available ROM
- 256 MB RAM
- VGA monitor with at least 1024 x 768 resolution, at least 256 colours

With the Sunways Monitor 2.0 software, all measured values stored in the Solar Inverter are retrieved and filed in a data bank. The software lets you visualise the measured values in diagrams or in tables.

You can flexibly manage as many PV systems as you like with up to 99 Solar Inverters and different types of connections (modem or direct).

To learn more about the software possibilities, please read the instructions on the CD ROM.

3.5 Sunways Portal and Sunways Communicator

To supervise a solar system with several Sunways Solar Inverters, we recommend using the Sunways Communicator. This device lets you connect your system to the Sunways portal where you can access your system data via the Internet. Moreover, it can warn you of system faults by email, fax, or SMS.

If you would like to find out more information about the Sunways Communicator, look it up on the supplied CD ROM. To learn more about the Sunways Communicator, please look up the information on the enclosed CD ROM.

3.6 Communication Link

Every Sunways Solar Inverter NT 10000 is equipped with the interfaces RS232, RS485, and USB, by which it can be connected to your PC. If the PV system and the PC are far apart, the data can also be retrieved via a modem link. If linked via the RS485 interface, up to 99 Solar Inverters can be monitored and read out.

Modem Link

For that purpose, a modem (remote modem) must be connected to the Solar Inverter. We recommend using the «ACER surf 56» modem by ACER as a remote modem. This accessory is available from your Solar Inverter dealer. For further suppliers, please visit our website www.sunways.de.

Connect the second modem (local modem) to the RS232 interface of your PC.



Modem types not recommended by Sunways are not necessarily guaranteed to work.

For the remote modem to automatically respond to an incoming call and open the line, it has to be initialised with the Sunways Monitor software prior to installation. For this, please also observe the software instructions.

Interface Cables

Depending on the type of link, different types of interface cables are needed. They are available from your Solar Inverter dealer. For further suppliers, please visit our website www.sunways.de.

Interface Transformer

If you wish to read out the Solar Inverter data with your PC via the RS485 interface, you need an interface transformer to transform the RS485 signals into PC-compatible RS232 signals. We recommend .

using products made by ICP Germany to ensure a reliable data transfer

To connect the interface transformer to a COM port (RS232) of your PC, use the «I-7520» model; to connect it to a USB-port of your PC, use the «I-7561» model. This accessory is available from your Solar Inverter dealer. For further suppliers, please visit our website www.sunways.de.



To set up the RS485 communication between the Solar Inverters properly, the RS485 addresses have to be set consecutively, starting with address 01 (see chapter «Setting the RS485 Address»).

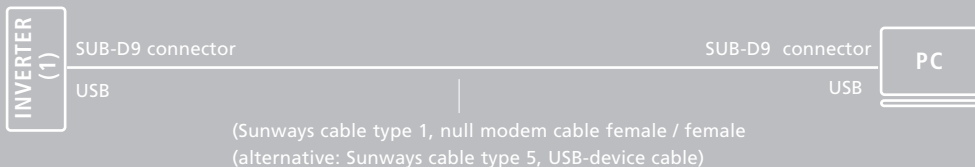
Linking and Interconnecting Possibilities

Depending on the distance to be overcome and the number of Solar Inverters, there are the following linking possibilities:

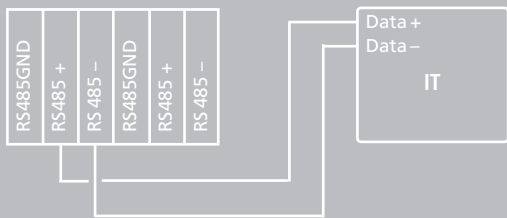
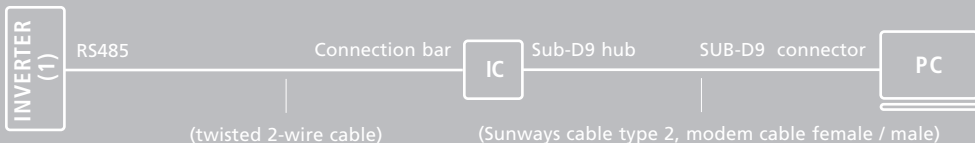
Type of Link	Distance	Solar System with 1 Solar Inverter	Solar System with up to 99 Solar Inverters (cross-linked via RS485)
Sunways Monitor Direct Link	PC not more than 5 - 25 m away	Connection of the PC via USB (max 5 m) or RS232 (max. 25 m) (see 1)	Connection between the PC and the Solar Inverter via USB with the RS485 address 01 (max. 5 m) (see 4)
Sunways Monitor Local Link	PC not more than 500 m away (minus RS485 cable length between the Solar Inverters)	Link between Solar Inverter and PC via RS485 bus, using an interface transformer at the PC (see 2)	Link between Solar Inverter and PC via RS485 bus, using an interface transformer at the PC (see 5)
Sunways Monitor Remote Link	PC more than 500 m away	Use of a remote modem at the Solar Inverter RS232; link via modem at the PC (see 3)	Connection of the remote modem via an interface transformer at the RS485 of the Solar Inverter with the RS485 address 01, link via modem at the PC (see 6)
Sunways Communicator Direct Link	Sunways Communicator not more than 25 m away	Use of an RS485 cable set (comes with the Sunways Communicator)	Use of an RS485 cable set (comes with the Sunways Communicator)

The cables and interface transformers that should be used are shown in the following diagrams.

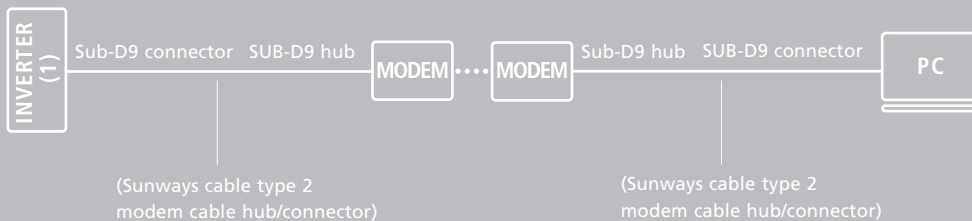
(1) Local link with a maximum distance of 25 m between the Solar Inverter and the PC



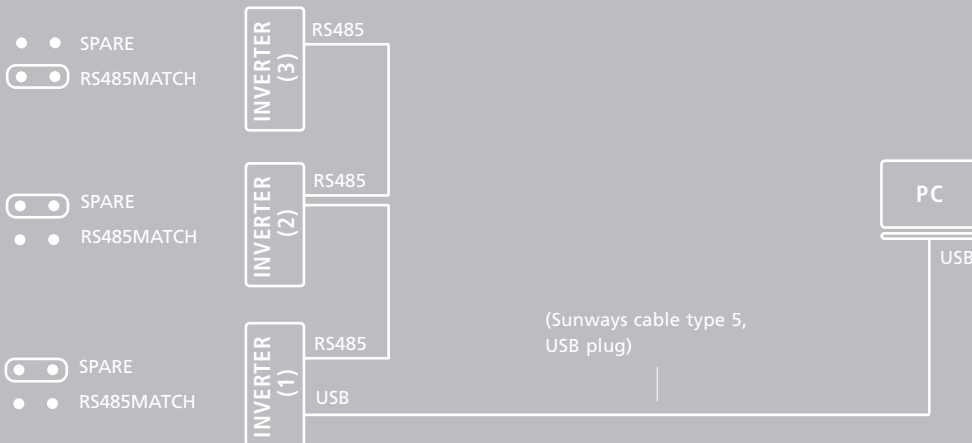
(2) Local link with an interface transformer between the Solar Inverter and the PC



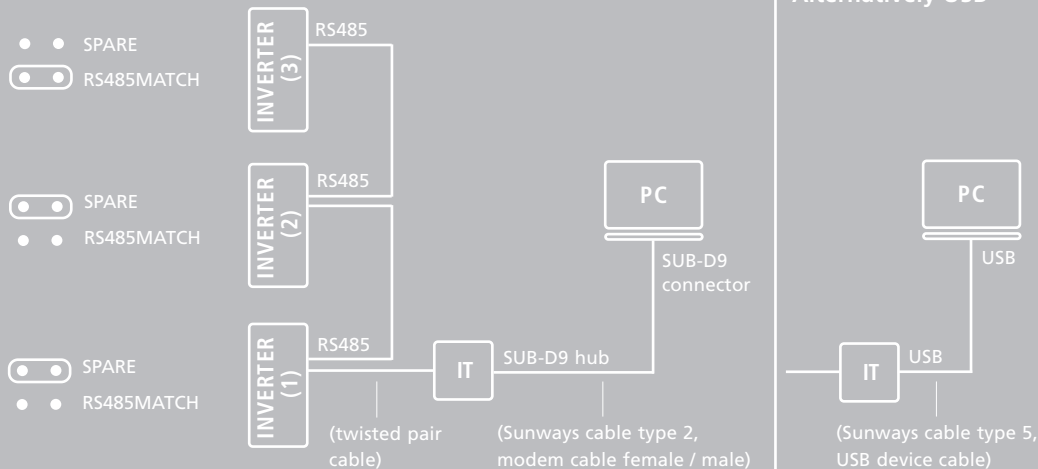
(3) Remote link with a modem between the Solar Inverter and the PC



(4) Local link for up to 99 Solar Inverters with a maximum distance of 25 m between the Solar Inverters and the PC



(5) Local link for up to 99 Solar Inverters (IT or USB)



Ad (5): Local Link for up to 99 Solar Inverters

With this interconnection, up to 99 Solar Inverters can be cross-linked and read out. That results in a maximum RS485 cable length of 500 m between the Solar Inverters and the interface transformer.

The RS485 signal is transferred from the first Solar Inverter in the row into the

interface transformer with the following allocation: «RS485 +» to «DATA+» and «RS485 -» to «DATA-».

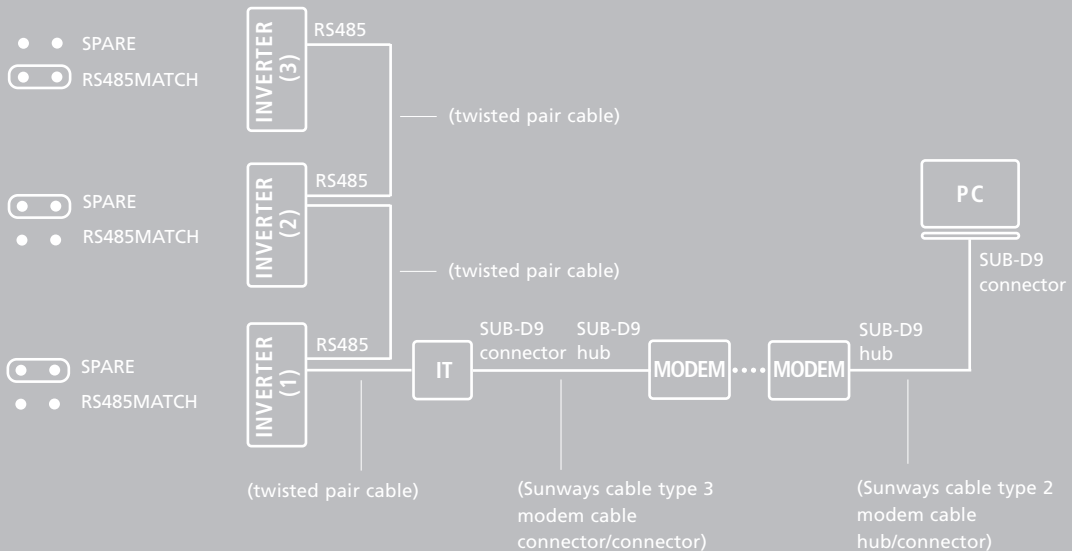
The interface transformer transforms the RS485 signal into RS232. It is linked to the PC with cable type 2 (standard modem cable). With the Solar Inverter that is furthest away from the interface transformer, the jumper RS485 MATCH must be closed.

With all other Solar Inverters, it has to be in the open position.



To identify the individual Solar Inverters, a clear RS485 has to be assigned to each of them. See chapter «Setting the RS485 Address».

(6) Remote link for up to 99 Solar Inverters with an interface transformer and a modem



Ad (6): Remote Link for up to 99 Solar Inverters

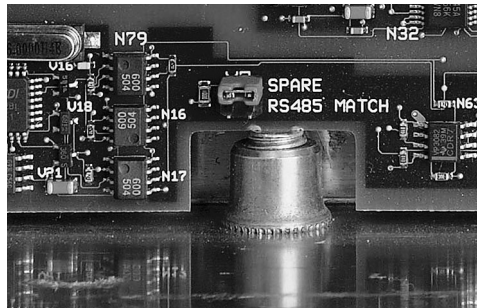
If you wish to connect several Solar Inverters to the remote monitoring system, the individual Solar Inverters must be cross-linked via RS485. The RS485 signal of the first Solar Inverter in the row is transferred into the interface transformer with the following allocation: «RS485 +» to «DATA+» and «RS485 -» to «DATA-». Connect the remote modem to the interface transformer. With the last Solar Inverter, the jumper «RS485 MATCH» must be closed. With all other Solar Inverters, it has to be in the open position.



To identify the individual Solar Inverters, a clear RS485 has to be assigned to each of them. See chapter «Setting the RS485 Address».

Finding the Jumper «RS485 MATCH» in the Solar Inverter

Please make sure the jumper «RS485 MATCH» is in the right position, considering the communication interconnection you have chosen. This jumper is on the underside of the interface circuit board.



Illustr.: Position of the jumper «RS485 MATCH»

3.7 Error Display

Your Solar Inverter works fully automatically. Should external or internal factors nevertheless lead to an error, an error number will be flagged on the display. Below, you will find a description of the error for each error number. If three consecutive error numbers are listed in the description, each of them refers to an energy unit of the Solar Inverter. E. g. for the description of errors 004 to 006, this means:

- **Error 004 refers to:**
DC inlet 1 (left DC connection)
energy unit 1 (lower control circuit board)
grid phase L1
- **Error 005 refers to:**
DC inlet 2 (middle DC connection)
energy unit 2 (middle control circuit board)
grid phase L2
- **Error 006 refers to:**
DC inlet 3 (right DC connection)
energy unit 3 (upper control circuit board)
grid phase L3

Errors 001 to 003

- **DC overvoltage**

A maximum PV generator no-load voltage of 850 V is admissible. All components of the DC inlet have a sufficient safety factor. If this limit is exceeded, the Solar Inverter will stop the injection, and «error 001» will be flagged, for example. That means an overvoltage of the PV generator on inlet 1 or on the lower energy unit.

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Errors 004 to 006

- **Frequency fault**

The Solar Inverter continuously monitors the applied grid frequency. Should it be outside the range specified in E DIN VDE 0126-1-1, the Solar Inverter will stop the injection, and «error 004» will be flagged, for example. That means a grid frequency error on grid phase L1 or on the lower energy unit.

Errors 007 to 009

· **Overheating**

Your Solar Inverter is designed for an ambient temperature of up to +40° C. If the maximum temperature of the heat sink is exceeded, the injection will stop. When the heat sink temperature has dropped, the Solar Inverter will automatically restart. If the upper heat sink overheats, for example, «error 009» will be flagged.

Errors 010 to 012

· **Grid undervoltage 1-phase**

Your Solar Inverter continuously monitors the voltage level of the injection phase. If it drops below the minimum admissible limit value, the Solar Inverter will stop the injection and only restart when the voltage value rises above the minimum admissible limit value. If the voltage of L1 drops below 160 V, the Solar Inverter can no longer be supplied, and the display will switch off. If there is a grid undervoltage on phase L3, for example, «error 012» will be flagged.

Errors 013 to 015

· **Grid overvoltage 1-phase**

Your Solar Inverter continuously monitors the voltage level of the injection phase. If it rises above the maximum admissible limit value, the Solar Inverter will stop the injection and only restart when the voltage value drops below the maximum admissible limit value. If there is a grid overvoltage on phase L2, for example, «error 014» will be flagged.

Error 016

· **Grid undervoltage 3-phase**

Your Solar Inverter is equipped with an intrinsically safe 3-phase grid monitoring system that complies with E DIN VDE 0126-1-1. The voltage level of phases L1, L2, and L3 is continuously monitored. If it drops below the minimum admissible limit value, the Solar Inverter will stop the injection and only restart when the voltage value rises above the minimum admissible limit value.

Errors 017 to 019

· **AFI fault current**

The error «AFI fault current» occurs if fault current has penetrated the PV system and the Solar Inverter has subsequently disconnected from the grid. The earth fault is monitored on the AC and on the DC side (universal current sensitive FI). If this error message occurs, the entire PV system must be checked for insulation faults. The functioning method complies with E DIN VDE 0126-1-1. In case of fault current at inlet 1 of the PV generator, for example, «error 017» will be flagged.

Errors 020 to 022

· **Insulation faults**

Prior to start-up, your Solar Inverter always checks the PV system for an earth fault or an insulation fault. Should such a fault be detected, the injection will not start. The functioning method complies with E DIN VDE 0126-1-1. In case of an insulation fault at inlet 2 of the PV generator, for example, «error 021» will be flagged.

Errors 023 to 025

· **DC injection**

Your Solar Inverter continuously monitors the quality of the injected electricity. If an increased share of DC current is detected in the injected electricity, the Solar Inverter will stop the injection. The Solar Inverter will only try to continue the injection after the system has been shut down and restarted manually, or automatically the next day.

Error 026

· **Isolated operation**

Your Solar Inverter is equipped with a high-quality redundant grid monitoring system that complies with E DIN VDE 0126-1-1 and continuously monitors the grid. If one of the monitoring phases fails, or if the phase relation changes between the individual conductors, the Solar Inverter will stop the injection and only restart when the error has been eliminated, i. e. when the AC grid works properly again.

Error 027

· Grid overvoltage 3-phase

Your Solar Inverter is equipped with an intrinsically safe 3-phase grid monitoring system that complies with E DIN VDE 0126-1-1. The voltage level of phases L1, L2, and L3 is continuously monitored. If it rises above the maximum admissible limit value, the Solar Inverter will stop the injection and only restart when the voltage value drops below the maximum admissible limit value.

Errors 028 to 030

· Surge fault

Your Solar Inverter continuously monitors the quality of the AC grid. If there are high voltage peaks in the grid, the Solar Inverter will stop the injection and try to restart. If such a surge impulse is detected at energy unit 3, for example, «error 030» will be flagged.

Errors 031 to 033

· Grid overvoltage > 10 percent

If the voltage of the injecting phase has exceeded 253 V for more than ten minutes, the Solar Inverter will stop the injection and only try to restart when the grid voltage is within the admissible range again. The functioning method complies with E DIN VDE 0126-1-1. If the applied grid voltage at phase L2 is higher than 253 V for more than 10 minutes, for example, «error 032» will be flagged.

Errors 034 to 036

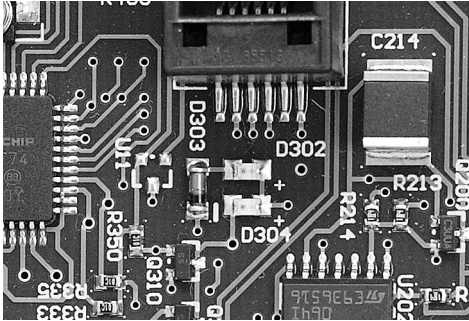
· Control fault

Your Solar Inverter is equipped with a self-monitored micro controller as a standard feature. If a fault occurs in the control sequence, the Solar Inverter will stop the injection and will only restart when the fault has been eliminated. If a fault occurs in the control circuit board of the third energy unit (upper energy unit), for example, «error 036» will be flagged.

There are two «D302» and «D304» LEDs each on the three control circuit boards; they describe the current status of the Solar Inverter:

LED green Led red	<input type="checkbox"/> <input type="checkbox"/>	on off	Solar Inverter is operating normally
LED green LED red	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	blinking blinking	Solar Inverter has detected a fault
Led green LED red	<input type="checkbox"/> <input checked="" type="checkbox"/>	off on	Internal control fault

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Illustr.: Operation indicator LED

3.8 Error Diagnosis

You can look up error causes yourself in the following list. Select the occurred error, and read the «Remedies» to find out how to eliminate it.

Error	Causes	Remedies
Errors 001 to 003 DC overvoltage	The maximum DC voltage has been exceeded. Too many modules are connected in series.	Check the rating of your PV generator. Reduce the number of modules in the DC inlet concerned, and recommission the system.
Errors 004 to 006 Frequency fault	The grid frequency is outside the admissible range.	Ask your power supply company about the stability and design of the grid.
Errors 007 to 009 Overheating	The maximum admissible ambient temperature of 40°C has been exceeded. The required air circulation was not considered during installation.	The installation site is not suitable. Please select a different installation site. If contamination is blocking the cooling system, clean the Solar Inverter.

4.1 Tyco Solarlok Connectors

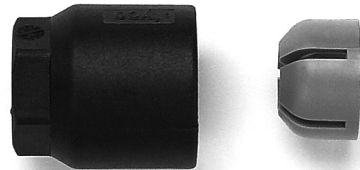


- Tyco Solarlok connectors may only be connected to permanent lines!
- They may not be disconnected under load!
- For this purpose, interrupt the electric circuit at a suitable point! Put a corresponding sticker on the lines near the Tyco Solarlok connector!
- To avoid an electric shock, always disconnect the Tyco Solarlok connectors from all other voltage sources during preparation!



Illustr.: Manual crimping tool for assembly of Tyco Solarlok connectors

Contamination of any kind (dust, moisture, etc.) has a negative effect on the working order of the connector system over its aspired service life. That especially applies to the working order of the seals and the crimping of the contacts. Therefore, make sure everything is clean during assembly.

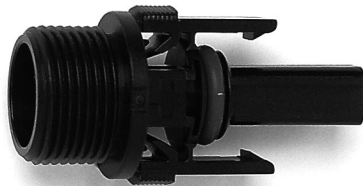


Illustr.: Tyco Solarlok connectors

With Tyco Solarlok connectors, different kinds of annular contacts are used for different conductor cross-sections. Make sure to use the right tools for these cross-sections. The enclosed Tyco Solarlok connectors are equipped with annular contacts for a cable cross-section of 4 mm. The enclosed seals have an internal diameter of 6 mm (for lines with a cladding diameter of 5.3 to 6.2 mm) and 8 mm (for lines with a cladding diameter of 7.2 to 8.0 mm). Make sure to use a seal that fits the cladding diameter of the cable used.

When installing the Tyco Solarlok connectors, proceed in the following order:

1. Bare the de-energised line by 8 mm
2. Crimp the annular contact
3. Slide the gland, the compression sleeve, and the seal onto the line
4. Engage the contact in the connector housing
5. Screw the lock nut on
6. Tightening torque for the cable gland: 1.5 Nm



4.2 List of Special Terms and Abbreviations

Designation	Description
AC	Alternating Current: grid current
AFI, RCD	Operator protection in the event of residual currents AFI: Universal Sensitive Residual Current RCD: Residual Current Device
DC	Direct Current PV generator side of the solar inverter
EMC	Electromagnetic Compatibility
EB	Electricity Board
IC	Interface Converter
IP	Identification of class of protection against external environmental influences (penetration of water and mechanical foreign bodies)
kW	Kilowatt
LCD	Liquid Crystal Display

Designation	Description
MPP	Maximum Power Point
Grid impedance	Resistance of grid, impedance
PT	Temperature sensor
PV	Photovoltaic
PV generator switch	DC load break switch to cut off the PV generator from the solar inverter

4.4 Conformity and Safety Declarations

Declaration of Conformity to EU Low Voltage Directive 73/23/EEC, Appendix III B

We hereby declare that the product described below, including the required accessories, conforms to the provisions of EU Directive 73/23/EEC following 93/68/EEC:

Product	Solar Inverter	
Manufacturer	Sunways AG, Photovoltaic Technology Macairestr. 3-5, D - 78467 Konstanz, Germany	
Type	Sunways NT 10000	
As from manufacturing date	15 September 2005	
Applied standards	Standard	EN 50178, EN 60950
	Title	Electronic equipment for use in power installations
	Edition	1998

Constance, 13 Sept. 2005

Place, date



Roland Burkhardt, Executive Board

Declaration of Conformity to EMC Directive 89/336/EEC, Including Changes 91/263/EEC and 93/68/EEC

We hereby declare that the product described below conforms to the provisions of EU Directive 89/336/EEC (EMC Directive with changes 91/263/EEC and 93/68/EEC):

Product	Solar Inverter
Manufacturer	Sunways AG, Photovoltaic Technology Macairestr. 3-5, D - 78467 Konstanz, Germany
Type	Sunways NT 10000
As from manufacturing date	15 September 2005
Applied standards	Standard EN 50082-2 (EN 61000-4-2, -4-3, -4-4, -4-6, -4-8) EN 55014-1; EN 55011; EN 61000-3-2; EN 61000-3-3; E DIN VDE 0126-1-1

Constance, 13 Sept. 2005

Place, date



Roland Burkhardt, Executive Board

Safety Clearance / Certificate of Compliance with the Directives on the Connection and Parallel Operation of In-Plant Generation Systems to the Low-Voltage Grid (VDEW [German Electricity Association], 4th Edition 2001)

We hereby declare that the following product complies with the provisions of the applicable VDE [German Association for Electrical, Electronic & Information Technologies] directive for operation parallel to the grid. In particular, the directives for connection and parallel operation of in-plant generation systems to the low-voltage grid of the energy supply company (VDEW 4th edition 2001) and DIN 0838 are complied with.

Product	Solar Inverter	
Manufacturer	Sunways AG, Photovoltaic Technology Macairestr. 3-5, D - 78467 Konstanz, Germany	
Type	Sunways NT 10000	
As from manufacturing date	15 September 2005	
Applied standards	Norm	
	Title	In-Plant Generation Systems to the Low-Voltage Grid
	Edition	4 th edition 2001

Explanations

Sunways Solar Inverters of series NT 10000 are Solar Inverters that inject in three-phases and are not capable of isolated operation. The NT 10000 consists of three single-phase inverters with a three-phase voltage monitoring system that inject into different phases. These integrated inverters control their phase angle independently of each other. They are equipped with a voltage-monitoring system and a three-phase monitoring system for any reduction of the linked voltage, in accordance with section 2.4.2 of the VDEW directive (4th edition 2001). Therefore, no always accessible isolating point is required (see section 2.1.2 Schaltstelle mit Trennfunktion [Control Point with Disconnection Function]). A routine test is carried out with each device to make sure the turn-off values of the three-phase voltage reduction protection are maintained. Subject to changes. Currently valid edition available at request.

For the latest valid version of this declaration, please visit our website www.sunways.de.

Constance, 13 Sept. 2005

Place, date



Roland Burkhardt, Executive Board

4.5 Terms and Conditions of Guarantee

· Duration of Guarantee

The duration of guarantee is five years, starting from the day the Solar Inverter is purchased by the end user. The guarantee card enclosed with the device must be completed and sent back to Sunways AG.

Please keep the original receipt with the date of purchase and the serial number. In case of a guarantee claim, it is required as evidence, together with the guarantee card.

· Conditions

Within the guarantee period, the Solar Inverter will be repaired in the factory in Constance, Germany, without material or labour being charged. Assembly costs shall be borne by the customer, unless something else has been agreed on.

The completed guarantee card must be sent to Sunways AG, Constance, within seven days after purchase.

In case of a guarantee claim, please

inform us beforehand, stating your name, address, phone number, email address (if applicable), and the serial number. The phone number is on the back of the user manual.

The Solar Inverter may only be shipped with the prior approval of Sunways AG. The approval will be granted as soon as the completed fault protocol has arrived, stating the occurred fault and the way you would like the guarantee claim to be processed. Devices sent to Sunways AG without prior notification cannot be accepted and repaired.

The time required to correct the fault must be granted. Sunways AG will try to correct the fault within 14 days after having received the device. If that is not possible, we will let you know the reason and when the fault will be corrected.

Please keep the original packaging, even after the guarantee period has run out. Forwarding companies may only accept the Solar Inverter if it is in the transport-proof original packaging. Therefore, please let us know if you have lost the original

packaging, prior to having the device picked up. We will be glad to send you a new packaging against payment.

- **Exclusion of Liability**

Claims and liability for damage directly or indirectly caused by the following reasons are excluded:

- interventions, changes, and repair attempts
- insufficient ventilation
- force majeure (e. g. lightning strike, water damage, vandalism, fire, overvoltage, storm, etc.)
- inappropriate transportation
- non-compliance with applicable regulations, or wrong installation/commissioning
- leakage of overvoltage of the varistors on the DC side at the PV generator

Any further-reaching or other claims for direct or indirect damage, especially claims for compensation including ones for positive breach of contract are excluded, unless they are compellingly prescribed by law.

4.6 General Exclusion of Liability

Although the accuracy and completeness of the information in this manual have carefully been checked, no liability whatsoever can be accepted for mistakes or omissions.

- Sunways AG reserves the right to change the hardware and software features described here at any time, without prior notification.
- Without the prior written approval of Sunways AG, this manual may not be duplicated, transferred, copied, or translated into other languages in any form or by any means, in part or in whole.
- Sunways AG does not accept responsibility for damage caused by false or lost data due to wrong operation or malfunctions of the Solar Inverter, the software, additional devices, or PCs.

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